THE EFFECT OF RESIDUAL FEED INTAKE ON PORCINE *LONGISSIMUS THORACIS ET LUMBORUM* QUALITY

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Abstract – Residual feed intake (RFI) can be described as the difference between an animal's actual feed intake and its predicted feed requirements for maintenance and growth. The objectives of this study were to determine the influence of divergence in RFI on porcine *longissimus thoracis et lumborum* (LTL) meat quality. pH, colour, water holding capacity and Warner Bratzler shear force were assessed for twenty commercial pigs from each of a low and high RFI group. RFI level had no effect on early postmortem pH in the LTL muscle. However, the ultimate pH significantly differed between the two groups, with the low RFI pigs having lower pH values. Low RFI pigs also showed higher cook loss but no negative impact was found for drip loss. The current study suggests that meat from low RFI pigs is not strongly impaired in terms of quality. However, selection for reduced RFI could potentially slightly impair the technological quality of pork through decreased cooking yield.

Key Words – RFI, feed conversion efficiency, pork meat quality

I. INTRODUCTION

Improving feed efficiency in pigs is a major goal in pig breeding, as feed accounts for 70 percent of the total production cost [1]. Feed conversion efficiency (FCE) is a measure of an animal's efficiency in converting feed into live weight [2]. An alternative measure of feed conversion ratio (weight gain:feed ratio) is residual feed intake (RFI), which can be described as the difference between an individual's actual feed intake and its predicted feed requirements for maintenance and growth [3]. A low RFI indicates a decreased energy required for maintenance and growth [4], therefore less feed is needed and less environmental pollution is produced. There is considerable evidence that selection for enhanced lean growth has had negative consequences for eating quality [5]. However, the relationship between RFI and meat quality is not fully elucidated. Therefore the objective of this study was to determine the effect of RFI on pork meat quality.

II. MATERIALS AND METHODS

Animals and experimental design. This study involved 40 commercial line Maxgro pigs from low and high residual feed intake groups (20 gilts and 20 boars) with the average final body weight of 99 kg. RFI was calculated as a regression of average daily feed intake (ADFI) on average daily gain (ADG), mid-test metabolic weight and their interactions with gender, gender alone and back fat, using PROC GLM in SAS (SAS, Cary, NC, USA). The pigs were categorised as the highest and lowest RFI within litter and gender. The pigs were transported from Teagasc Pig Production Development Unit in Moorepark to Teagasc Food Research Centre, Ashtown for slaughter at a pilot scale licensed abattoir, which occurred in 2 sessions a week apart. Prior to slaughter, the animals were fasted for 18 hours. The pigs were electronically stunned followed by exsanguination. The carcasses were centrally split into two sides and placed in a chill room at 4°C.

Meat quality measurements

pH. pH of *Longissimus thoracis et lumborum* (LTL) muscle was measured at 45 minutes (pH_{45}) and 24 hours (pH_u) postmortem, using a portable Hanna pH meter (Hanna Instruments, Woonsocket, RI, USA). A previously calibrated pH probe was inserted between the 12th and 13th rib.

Colour. Meat colour of the fresh chops and after 1h of blooming was recorded at day 1 postmortem. It was measured with MiniScan XE Plus (Hunter Associates Laboratory Inc., Virginia, USA) using CIE L* (lighteness), a* (redness) and b* (yellowness) colour scale. The measurements were taken at three locations on each chop and averaged.

Drip loss (DL). The muscle chops were trimmed of the adipose tissue and perimysium at day 1 postmortem, to a weight of 80g ± 1g. They were then weighed and kept at 4°C in plastic bags. After 48h the samples were dried with a paper towel, weighed and expressed as percentage of weight loss.

Cook loss (CL). Samples were frozen at -20°C on day 1 (D1) and day 7 (D7) postmortem, and subsequently were thawed in bags at circulating water bath at 20°C. The muscle chops were then trimmed of external fat, dried with a paper towel and weighed. They were placed in plastic bags and immersed in a water bath (Grant Instruments Ltd, England) at 77 °C until they reached a core temperature of 75°C (Eirelec Ltd, Ireland). The samples were allowed to cool at room temperature. Weight of the chops was recorded followed by refrigerated storage. The cook loss was expressed as a percentage of the raw weight of the chop.

Warner Bratzler shear force (WBSF). After cook loss was determined, the samples were used to measure Warner Bratzler shear force (WBSF) according to AMSA guidelines. Briefly, six cores of 1.25cm diameter were obtained from each sample. The cores were cut in parallel to the longitudinal orientation of fibres and they were sheared using Instron model 5543 and data analysed using Blue Hill software (Instron Ltd., Buckinghamshire, UK).

Statistical analysis. The General Linear Model (GLM) procedure in the SAS system (version 9.3, SAS INST., Inc., Cary, NC, 2002-2003) was used to evaluate associations between high and low RFI animals and meat quality traits (dependent variables) in the Maxgro pigs (n = 40). Other factors such as sex and slaughter date were also included in the model.

III. RESULTS AND DISCUSSION

The meat quality traits of LTL muscle in high and low RFI pigs are shown in Table 1 and the effect of sex on pork LTL muscle quality is presented in Table 2. The RFI * sex interactions for the meat quality traits were not significant in the studied population which is in accordance with previous studies [6].

Table 1 Meat quality traits of *Longissimus thoracis et lumborum* muscle (LTL) in pigs from low (L) and high (H) residual feed intake (RFI) groups

Trait	L RFI[1] n=20	H RFI[1] n=20	SE	P-value
pH_{45}	6.40	6.52	0.06	0.131
pH_u	5.54	5.70	0.04	0.005**
L*	54.36	54.22	0.67	0.881
a*	4.98	4.77	0.20	0.454
b*	13.38	13.63	0.25	0.483
1 h L*	54.65	54.03	0.73	0.555
1h a*	5.56	5.70	0.21	0.648
1h b*	13.57	13.60	0.26	0.930
% DL	4.94	4.51	0.49	0.535
%CL D1	36.13	34.42	0.50	0.023*
%CL D7	37.63	37.19	0.45	0.494
WBSF D1	38.06	33.18	1.88	0.077$
WBSF D7	30.63	28.10	1.51	0.245

[1]Least square means for each trait; $ P<0.1; *P<0.05; **P<0.01

Divergence in RFI was not associated with an effect on the early postmortem pH in the LTL muscle. However the ultimate pH significantly differed between the two groups ($p < 0.01$), with the LRFI pigs showing decreased pH values. This is supported by previous studies which reported no effect on early pH and significantly reduced ultimate pH in LRFI pigs, compared to HRFI pigs [7, 8, 9].Boars exhibited higher pH_u measurements comparing to the gilts, which is not in agreement with Nold et al., [10] who reported no significant differences in ultimate pH between males and females. The low RFI pigs showed a tendency towards an association with decreased meat tenderness at day 1 postmortem ($p < 0.1$) although there was no difference at day 7. No significant association with tenderness was found in a

previous study carried out on low RFI pigs versus control pigs [11]. However Smith el al. [11] proposed that tenderness of meat produced by LRFI pigs could be negatively affected by greater calpastatin activity, resulting in decreased postmortem protein degradation. There was no significant impact of sex on tenderness in the present study, which contrasts with previous data of Bartongade [12], who reported that gilts had higher scores for tenderness in comparison to boars.

Table 2 The effect of sex on pork *Longissimus thoracis et lumborum* (LTL) muscle quality

Trait	Gilt[1] n=20	Boar[1] n=20	SE	P-value
pH_{45}	6.41	6.51	0.06	0.229
pH_u	5.56	5.68	0.04	0.036*
L*	55.57	53.00	0.67	0.011*
a*	4.80	4.95	0.20	0.588
b*	13.37	13.64	0.25	0.432
1 h L*	55.70	52.97	0.73	0.013*
1h a*	5.62	5.64	0.21	0.956
1h b*	13.58	13.58	0.26	0.999
% DL	5.39	4.05	0.49	0.062$
%CL D1	35.17	35.38	0.50	0.765
%CL D7	37.48	37.35	0.45	0.838
WBSF D1	34.19	37.05	1.88	0.292
WBSF D7	28.67	30.06	1.51	0.517

[1]Least square means for each trait; $ P<0.1; *P<0.05

Selection for low RFI has been reported to have a negative impact on drip loss [9]. In the present study such an association was not found, but reduced RFI was negatively associated with cook loss at day 1 postmortem ($p < 0.05$), but the cook loss at day 7 postmortem was not affected. Unfavourable associations between lower pH_u and increased cook loss with a tendency towards reduced tenderness were observed in the low RFI pigs. Silva et al. [13] postulated that lower water holding capacity of meat with decreased ultimate pH can result in tougher beef. No negative impact of low RFI on meat colour was found. However, meat from the gilts was found to have higher L* values, compared to the meat from the boars ($p < 0.05$), which contrasts with previous findings [10, 14, 15].

IV. CONCLUSION

The current study demonstrated that low RFI is associated with reduced ultimate pH. While the values for both RFI groups were within the normal pH range for the production of acceptable quality pork, meat produced by the low RFI pigs may be less prone to being dark, firm and dry (DFD) due to their increased pH decline postmortem. However reduced RFI could potentially be associated with impaired technological quality of pork through decreased cooking yield.

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